

Application No.: 10/526,713
Filing Date: 9/23/2005

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AMENDMENTS TO THE CLAIMS

1. (Canceled)

2. (Currently amended) A movement device ~~for facilitating movement of a joint of a patient's body, comprising movement facilitation devices capable of being coupled to a patient, so as to facilitate independent movement of at least two joints of a limb or digit, said movement device comprising:~~

a) at least a first and a second movement facilitation device, the first movement facilitation device being disposed so as to facilitate a first movement of a corresponding first joint of said limb or digit, the second movement facilitation device being disposed so as to facilitate a second movement of a corresponding second joint of said limb or digit, wherein the first movement can be performed independently of the second movement, and each of the movement facilitation devices comprising:

an actuator capable of causing the corresponding joint to move,
operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing ~~at least one~~ a corresponding feedback signal relating to at least one quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint, and

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move; and

b) controlling means capable of providing ~~an~~ the input signals to one of the operating means for controlling ~~the~~ said operating means;

wherein ~~the~~ each sensor is capable of providing the corresponding ~~at least one~~ feedback signal to means selected from the corresponding operating means and the controlling means so as to affect the operation of one of the actuators.

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3. (Currently amended) The movement device of claim 2 wherein the each actuator is capable of causing the corresponding joint to move in a pivotal manner.
4. (Currently amended) The movement device of claim 2 wherein the each support structure is capable of being coupled to the patient's body proximate the corresponding joint.
5. (Currently amended) The movement device of claim 2 wherein the each support structure is coupled to the corresponding actuator by a cable.
6. (Currently amended) The movement device of claim 5 wherein the cable passes over a knuckle such that, in use, the knuckle is located on top of the corresponding joint for providing mechanical advantage to the cable.
7. (Currently amended) The movement device of claim 5 wherein at least a portion of the cable is located within a tube, said tube being associated with the corresponding support structure.
8. (Currently amended) The movement device of claim 2 wherein the each actuator comprises one of a motor, a material which changes shape when an electrical potential thereacross is altered, a material which contracts when operated and a material which when operated decreases in length.
9. (Currently amended) The movement device of claim 2 wherein the each actuator comprises a material which changes shape when an electrical potential thereacross is altered, said actuator being capable of incremental actuation.
10. (Currently amended) The movement device of claim 2 additionally comprising securing means for securing the support structures to the patient's body.
11. (Currently amended) The movement device of claim 2 wherein the support structures comprises a glove for enveloping at least a portion of the patient's body proximate the at least one two joints.
12. (Currently amended) The movement device of claim 2 wherein the each support structure comprises a first member positioned so as not to interfere with an ability of the at least one corresponding joint to move, said first member being located in a position selected from the group consisting of on top of the corresponding joint and at the side of the corresponding joint.

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13. (Currently amended) The movement device of claim 2 wherein ~~the~~ each actuator comprises at least one ratchet capable of allowing movement in one direction and of restricting movement in the an opposite direction, to enable incremental actuation.

14. (Currently amended) The movement device of claim 2 wherein ~~the~~ each sensor comprises a force-position transducer for generating the ~~at least one~~ corresponding feedback signal.

15. (Currently amended) The movement device of claim 14 wherein the transducer comprises:

a) a radiation source and one or more detectors capable of detecting radiation from the radiation source, wherein at least one detector is free to move relative to the radiation source, and

b) a return mechanism coupled to ~~the one or more~~ at least one detectors, wherein ~~each of the one or more~~ at least one detectors is capable of generating one ~~of the at least one~~ the corresponding feedback signals, wherein said feedback signal is dependent on an intensity of the radiation from the radiation source incident on said detector, said feedback signal relating to at least one quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint.

16. (Original) The movement device of claim 15 wherein the radiation is selected from the group consisting of light, infra-red, magnetic, ultrasonic and electromagnetic radiation.

17. (Currently amended) The movement device of claim 2 additionally comprising a lock for locking at least one of the joints in a fixed position.

18. (Original) The movement device of claim 2 having means to set a safety limit, said means being selected from the group consisting of a safety force release for setting a safety limit for force applied to the joint and an adjustable mechanical stopper for setting a safety limit for position of the joint.

19. (Currently amended) The movement device of claim 2 having software in said controlling means, said software having a settable safety limit for at least one of the positions of the joints and the forces applied to the joints.

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20. (Canceled)

21. (Currently amended) The movement device of claim 2 wherein the controlling means is capable of controlling the movement facilitation devices ~~in a manner selected from the group consisting of independently and so as to work together so that the independent movements of the two joints~~ work together towards a specific aims.

22. (Currently amended) The movement device of claim 2 ~~having a wherein the first and a the second movement facilitation devices which~~ can work in opposition to one another, said first and second movement facilitation devices being capable of being coupled to the patient's body proximate the same joint, wherein the first movement facilitation device, when operated, flexes the joint, and the second movement facilitation device, when operated, extends the joint.

23. (Currently amended) The movement device of claim 2 wherein a single movement facilitation device is capable of flexing and of extending the corresponding joint.

24. (Canceled)

25. (Currently amended) The movement device of claim 2 wherein the controlling means comprises a computer adapted to receive the corresponding ~~at least one~~ feedback signal from one of the sensors and to use ~~the at least one~~ said feedback signal to provide one of the input signals to one of the operating means.

26. (Original) Use of a movement device according to claim 2 to maintain and increase good condition of a person's hand and hand function following one or more events selected from the group consisting of spinal cord injury, burns, stroke, the onset of arthritis, septic arthritis, oedema, peripheral nerve injury and other syndromes influencing the condition or function of the upper extremity, including cerebral palsy, hand trauma and hand surgery, said use comprising the step of causing the movement device to move, thereby causing at least one joint of the person's hand to move.

27. (Currently amended) A system for applying Continuous Passive Motion therapy to a at least two joints of a limb or digit of a patient, comprising:

a) at least a first and a second movement facilitation device, the first movement facilitation device being disposed so as to facilitate a first movement of a corresponding first joint of said limb or digit, the second movement facilitation device

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being disposed so as to facilitate a second movement of a corresponding second joint of said limb or digit, wherein the first movement can be performed independently of the second movement, and each of the movement facilitation devices comprises:

an actuator capable of causing the corresponding joint to move,

b) operating means coupled to the actuator for operating the actuator in response to an input signal,

e) a sensor capable of providing ~~at least one~~ a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint,

d) a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move[.];

b) e) controlling means capable of providing ~~an~~ the input signals to one of the operating means for controlling the said operating means;

c) f) a control system comprising a user interface, said control system being coupled to the controlling means in order to provide user input to the controlling means; and

d) g) a power supply for supplying power to at least one of the controlling means and any of the operating means,

wherein ~~the~~ each sensor is capable of providing the ~~at least one~~ corresponding feedback signal to means selected from the corresponding operating means and the controlling means so as to control the operation of the actuators.

28. (Currently amended) A method for independently causing flexion or extension of a at least two joints of a limb or a digit of a patient, said method comprising:

a) securing to at least a portion of the patient's body proximate the said at least two joints a movement device comprising:

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at least a first and a second movement facilitation device, the first movement facilitation device being disposed so as to facilitate a first movement of a corresponding first joint of said limb or digit, the second movement facilitation device being disposed so as to facilitate a second movement of a corresponding second joint of said limb or digit, wherein the first movement can be performed independently of the second movement, and each of the movement facilitation devices comprises: an actuator capable of causing the corresponding joint to move; operating means coupled to the actuator for operating the actuator in response to an input signal; a sensor capable of providing at least one a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint[.]; a support structure coupled to the actuator and capable of being coupled to the patient's body such that, in use, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move, and

controlling means capable of providing an the input signals to the corresponding operating means for controlling the corresponding operating means,

wherein the each sensor is capable of providing the corresponding at least one feedback signal to means selected from the corresponding operating means and the controlling means so as to control the operation of one of the actuators; and

b) operating the operating means whereby one of the actuators causes the corresponding joint to flex or extend.

29. (Currently amended) The method of claim 28, said method further comprising:

- c) passing the at least one of the feedback signals to the controlling means,
- d) determining said corresponding quantity using the controlling means,
- e) using said corresponding quantity to generate one of the input signals, and
- f) providing the said input signals to one of the operating means by means of the controlling means for a purpose selected from the group consisting of controlling

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speeds and ranges of movement of the joints, controlling a forces applied to the joints, controlling the positions so that a position limits ~~is~~ are not exceeded and controlling the forces so that a maximum force limits ~~is~~ are not exceeded.

30. (Currently amended) A method for splinting a first joint of a limb or digit of a patient whilst moving a second joint of said limb or digit, said method comprising:

a) securing to at least a portion of the patient's body proximate the joints a movement device comprising:

a first and a second movement facilitation device, the first movement facilitation device being disposed so as to facilitate a first movement of the corresponding first joint, the second movement facilitation device being disposed so as to facilitate a second movement of a corresponding second joint, wherein the first movement can be performed independently of the second movement, and each of the movement facilitation devices comprises an actuator capable of causing the corresponding joint to move; operating means coupled to the actuator for operating the actuator in response to a first input signal; a sensor capable of providing at least one a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint; a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move, and

controlling means capable of providing ~~an~~ the first input signals to one of the operating means for controlling the operating means,

wherein the each sensor is capable of providing the corresponding at least one feedback signal to means selected from the corresponding operating means and the controlling means so as to control the operation of one of the actuators, said movement device being capable of flexing and of extending the joints;

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b) operating the operating means of the first movement facilitation device whereby the actuator of said first movement facilitation device causes the first joint to move the first joint to a desired position; and

c) providing a second input signal to the operating means of the first movement facilitation device such that the actuator of said movement facilitation device splints the first joint; and

d) operating the operating means of the second movement facilitation device whereby the actuator of said movement facilitation device causes the second joint to move.

31. (Currently amended) A method for splinting a first joint of a limb or a digit of a patient whilst moving a second joint of said limb or digit, said method comprising:

a) securing to at least a portion of the patient's body proximate the joints a movement device comprising:

a first, second and third movement facilitation devices and a second movement facilitation device which, the first movement facilitation device being disposed so as to facilitate a movement of the corresponding first joint, the second movement facilitation device being disposed so as to facilitate a movement of the corresponding second joint, the third movement facilitation device being disposed so as to facilitate a movement of the first joint, wherein the movement of the first movement facilitation device can be performed independently of the movement of the second facilitation device and wherein the first and third movement facilitation devices can work in opposition to one another, wherein the first movement facilitation device, when operated, flexes the joint, and the second third movement facilitation device, when operated, extends the joint, each of said the first, second and third movement facilitation devices comprising:

an actuator capable of causing the corresponding joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing at least one feedback signal relating to a quantity selected from the group consisting of a force exerted on the

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corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint, and

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move, and

said movement device also comprising controlling means capable of providing an input signal to the operating means of each movement facilitation device for controlling the operating means thereof, wherein the sensors of each movement facilitation device is capable of providing the ~~at least one~~ corresponding feedback signal to means selected from the corresponding operating means and the controlling means so as to control the operation of the corresponding actuator, said movement device being coupled to at least a portion of the patient's body proximate the joints;

b) operating the operating means of the first and third movement facilitation devices thereby operating the actuators of ~~the first and the second~~ said movement facilitation devices so that the first movement facilitation device and the ~~second~~ third movement facilitation device work in opposition to one another ~~to apply an equal and opposite force~~ in order to splint the first joint[.] ; and

c) operating the operating means of the second movement facilitation device whereby the actuator of said movement facilitation device causes the second joint to move.

32. (Currently amended) A method for flexing a first joint of a limb or digit of a patient while splinting a second joint of the limb or digit of said patient, comprising:

a) securing to the limb or digit proximate the first and second joints a movement device comprising a first and a second movement facilitation device wherein the first movement facilitation device is secured to the limb proximate an end thereof such that, when operated, it creates a first movement which is capable of flexion of flexes both the first joint and the second joint, and the second movement facilitation device, when operated, creates a second movement which is capable of extension of extends the

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second joint, wherein the first movement can be performed independent of the second movement, and each of said movement facilitation devices comprising:

an actuator capable of causing the corresponding movement joint to move,
operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing ~~at least one~~ a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on ~~the a~~ joint, a force exerted by ~~the a~~ joint, a position of ~~the a~~ joint, a pressure exerted on ~~the a~~ joint and a pressure exerted by ~~the a~~ joint, and

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the a joint to move, and

said movement device also comprising controlling means capable of providing an input signal to the operating means of each movement facilitation device for controlling the operating means, wherein ~~the each~~ sensor is capable of providing the corresponding at least one feedback signal to means selected from the corresponding operating means and the controlling means so as to control the operation of one of the actuators.

b) operating the operating means of the second movement facilitation device thereby causing the actuator of the second movement facilitation device to extend the second joint; and

c) operating the operating means of the first movement facilitation device so as to flex the first joint and not cause flexion of the second joint.

33. (Currently amended) A method for splinting a first joint of a limb or digit of a patient while moving a second joint of said limb or digit, said method comprising:

a) securing to at least a portion of the patient's body proximate the joints a movement device comprising first and second movement facilitation devices, the first movement facilitation device being disposed so as to facilitate movement of the first joint and the second movement facilitation device being disposed so as to facilitate movement

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of the second joint, wherein movement of the first joint can be performed independently of movement of the second joint, each of said movement facilitation devices comprising:

an actuator capable of causing the corresponding joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing ~~at least one~~ a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint,

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move; and

the movement device further comprises controlling means capable of providing an input signal to one of the operating means for controlling the said operating means, wherein the each sensor is capable of providing the ~~at least one~~ corresponding feedback signal to means selected from the corresponding operating means and any of the controlling means so as to control the operation of the corresponding actuator, said movement device having a feature that allows locking of the first joint once a desired posture is reached, and said feature being located in a location selected from the group consisting of at the actuator of the first movement facilitation device and at the first joint, and said feature being selected from the group consisting of a feature that allows mechanical locking, a press-lock, a manually actuated lock and an actuator operated lock; and

b) operating the operating means of the first movement facilitation device whereby the actuator of said movement facilitation device causes the first joint to move the first joint to a desired position; and

c) locking the first joint by means of the feature that allows locking; and

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d) operating the operating means of the second movement facilitation device whereby the actuator of said movement facilitation device causes the second joint to move.

34. (Currently amended) A method for facilitating grasping motion of a hand of a patient comprising:

a) securing to the hand a movement device, said movement device comprising controlling means capable of providing input signals to ~~a plurality of~~ at least a first and a second movement facilitation devices, each of said movement facilitation devices being coupled to the hand proximate a joint of the hand, the first movement facilitation device being disposed so as to facilitate a first movement of a corresponding first joint of said hand, the second movement facilitation device being disposed so as to facilitate a second movement of a corresponding second joint of said hand, wherein the first movement can be performed independently of the second movement, and each of said movement facilitation devices comprising:

an actuator capable of causing the corresponding joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing ~~at least one~~ a corresponding feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint, said the sensor being capable of providing the at least one feedback signal to means selected from the operating means and the controlling means so as to control the operation of the actuator and

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move;

b) programming the controlling means to cause the hand to adopt an open position;

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c) programming the controlling means with at least one of: an order of operation of joints, a degree of flexion for each joint, a range of motion for each joint, a strength of movement, and a speed of overall hand closure; and

d) operating the actuators by means of the input signals from the programmed controlling device in order to facilitate grasping motion.

35. (Currently amended) A method for applying Continuous Passive Motion Therapy to at least two joints of a limb or digit of a patient, comprising:

a) securing a movement device to the patient's body proximate the joints, said movement device comprising controlling means capable of providing an input signal to [a] at least a first and a second movement facilitation devices, said, the first movement facilitation device being disposed so as to facilitate a first movement of a corresponding first joint of said limb or digit, the second movement facilitation device being disposed so as to facilitate a second movement of a corresponding second joint of said limb or digit, wherein the first movement can be performed independently of the second movement, and each movement facilitation device comprising:

an actuator capable of causing the corresponding joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing to means selected from the operating means and the controlling means at least one feedback signal relating to a quantity selected from the group consisting of a force exerted on the corresponding joint, a force exerted by the corresponding joint, a position of the corresponding joint, a pressure exerted on the corresponding joint and a pressure exerted by the corresponding joint, and

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the corresponding joint to move;

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b) programming the controlling means with a program for controlling the movement devices to perform a cycle comprising flexion and extension of the joints between 1 and 10000 times; and

c) causing the controlling device to run the program.

36. (Currently amended) A method for determining at least one parameter selected from the group consisting of an applied force provided to a joint of a patient, an applied force provided by the joint, a pressure provided to the joint, a pressure applied by the joint and a position of the joint comprising:

a) securing to at least a portion of the patient's body proximate the joint a movement device comprising:

an actuator capable of causing the joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing at least one feedback signal relating to a quantity selected from the group consisting of a force exerted on the joint, a force exerted by the joint, a position of the joint, a pressure exerted on the joint and a pressure exerted by the joint,

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the joint to move, and

controlling means coupled to the operating means for controlling the operating means;

b) applying a force by or to the joint of the patient; and

c) determining from the feedback signal a measurement of at least one of the applied force provided to the joint, the applied force provided by the joint, the pressure provided to the joint, the pressure applied by the joint and the position of the joint[.] ; and

d) calculating from the measurement, the selected parameter.

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37. (Currently amended) A method for monitoring at least one parameter selected from the group consisting of the position of a joint and a force exerted by the joint comprising:

a) securing to at least a portion of the patient's body proximate the joint a movement device comprising:

an actuator capable of causing the joint to move,

operating means coupled to the actuator for operating the actuator in response to an input signal,

a sensor capable of providing at least one feedback signal relating to a quantity selected from the group consisting of a force exerted on the joint, a force exerted by the joint, a position of the joint, a pressure exerted on the joint and a pressure exerted by the joint,

a support structure coupled to the actuator and capable of being coupled to the patient's body such that, when coupled to the patient's body, the support structure is disposed so that the actuator is capable of causing the joint to move, and

controlling means coupled to the operating means for controlling the operating means,

wherein the sensor comprises a transducer comprising a radiation source and one or more detectors capable of detecting radiation from the radiation source wherein at least one detector is free to move relative to the radiation source, and a return mechanism coupled to the one or more detectors, wherein each of the one or more detectors is capable of generating one of the at least one feedback signals, wherein said feedback signal is dependent on an intensity of the radiation incident on said detector;

b) causing the joint to apply a force;

c) monitoring the intensity of the intensity of radiation incident on the or each detector; and

d) using the intensity of radiation to determine at least one parameter selected from the group consisting of the position of the joint and the force exerted by the joint.

38. (Currently amended) A sensing device for sensing a quantity selected from the group consisting of a force exerted on a joint of a patient's body, a force exerted by the joint, a

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position of the joint, a pressure exerted on the joint and a pressure exerted by the joint, said device comprising:

a) a sensor capable of providing a signal relating to a quantity selected from the group consisting of a force exerted on the joint, a force exerted by the joint, a position of the joint, a pressure exerted on the joint and a pressure exerted by the joint, said sensor comprising a transducer comprising a radiation source, one or more detectors capable of detecting radiation from the radiation source, wherein at least one detector is free to move relative to the radiation source, and a return mechanism coupled to the one or more detectors, wherein each of the one or more detectors is capable of generating a feedback signals dependent on an intensity of the radiation incident on said detector; and

b) a support structure coupled to the sensor and capable of being coupled to the subject's body such that, when coupled to the patient's body, the support structure is disposed so that the sensor is capable of providing a signal relating to the quantity.

39. (Currently amended). A force-position transducer comprising:

a) a radiation source and one or more detectors capable of detecting radiation from the radiation source, wherein at least one detector is free to move relative to the radiation source, and

b) a return mechanism coupled to the one or more detectors,

wherein each of the one or more detectors is capable of generating a signal dependent on an intensity of radiation from the radiation source incident on said detector.